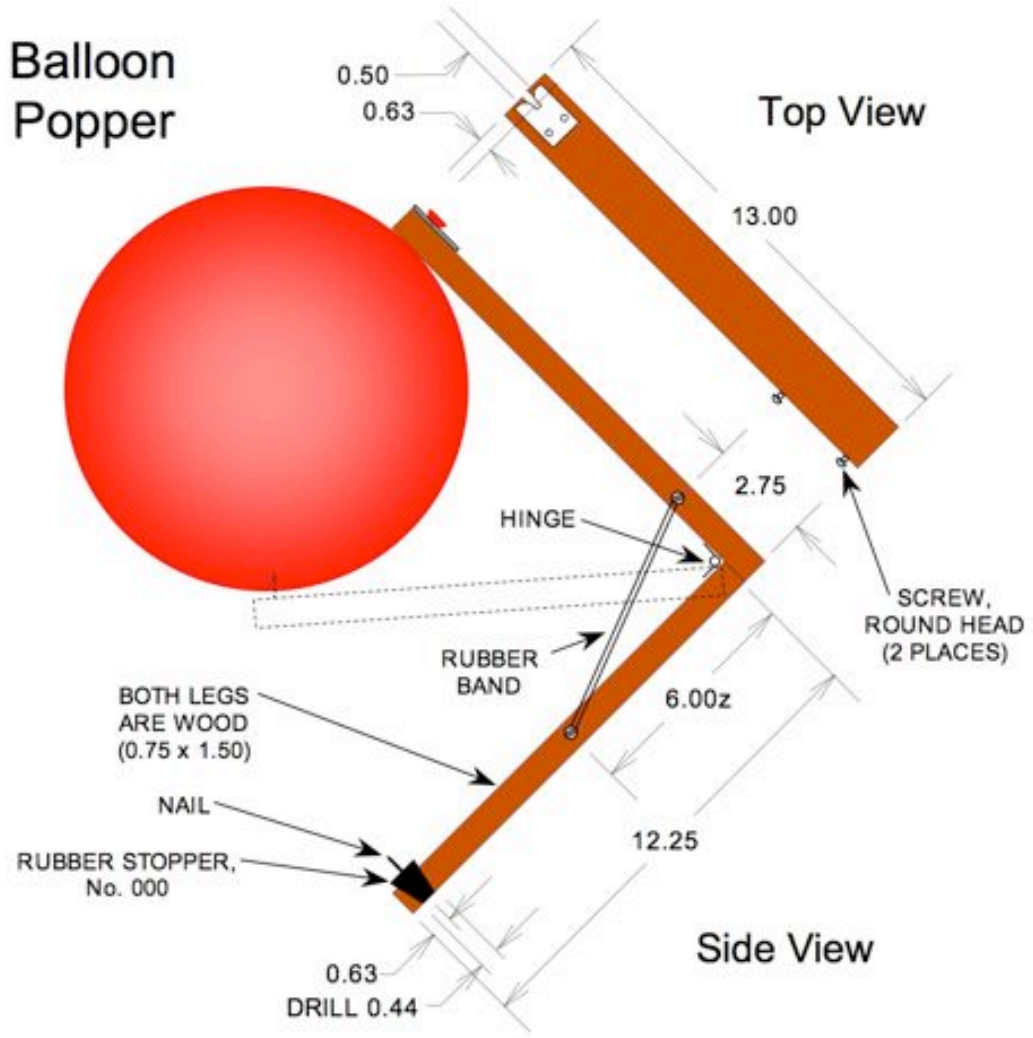
MICROGRAVITY BALLOON POPPER



An alternative to the *Falling Weight Apparatus* in
***Microgravity: A Teacher's Guide with Activities in Science, Mathematics, and Technology* (EG-1997-08-110-HQ), pp. 84-85.**

For more information, contact:

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MICROGRAVITY BALLOON POPPER

MATERIALS and TOOLS

- 1 piece of wood, 1x2x13 inches (actual size 0.75 x 1.5 x 13 inches)
- 1 piece of wood, 1x2x12.25 inches (actual size 0.75 x 1.5 x 12.25 inches)
- 1 hinge, with mounting screws
- 2 round-head, wood screws (e.g., #8, 3/4-inch long)
- 1 small nail or brad (optionally mounted in a rubber stopper)
- rubber band(s)
- small round balloons (e.g., 5 inch)
- drill and bits
- screwdriver

CONSTRUCTION

1. Bevel the end of the 12.25-inch piece of wood where the nail will be mounted as shown in the figure. This helps ensure that balloon is hit by the nail rather than just by the end of the wooden board.
2. In the 12.25-inch piece of wood, drill a hole for mounting the nail at 5/8 inch from the beveled end. For the device shown, a 7/16-inch hole was used and the nail was mounted in a #000 rubber stopper. Alternatively, the nail could be mounted directly in a small pilot hole. A pilot hole is necessary to avoid splitting the thin wood when nailing near the end. Alternatively, a sharp-ended screw could be installed in a pilot hole so that it protrudes above the wood surface enough to contact the balloon.
3. There are a variety of ways to mount the balloon to the 13-inch piece of wood. Regardless of the method used, it is important that the mounting be free of splinters and sharp edges. It should also hold the balloon securely in place.
    a. The balloon may be attached with a wooden clothes pin, a piece of tape, a rubber band, hook and loop material, or a binder clip fastened to the wood piece.
    b. To attach the balloon with string and tape as described in the microgravity teachers guide, drill a 1/2-inch hole at 5/8 inch from an end of the 13-inch piece of wood. The balloon knot and neck can be pulled through and taped in place.
    c. For the device shown in the figure, the wood piece was slotted and a notched clip was attached with wood screws.
4. Install the two round-head wood screws in the locations shown so that the heads protrude about 3/16 inch. Attach the two wood pieces with the hinge so the shorter wood piece butts against the longer piece. Connect the two protruding screws with a taut rubber band.

PREPARATION

1. The choice of a rubber band is important. It should be taut when the apparatus is held to drop; but, it should allow the lower arm to fall to the extent shown in the photographs here.
2. When the Balloon Popper is stored, the rubber band should be removed so that it doesn't become stretched.
3. The balloon should be inflated so that it will easily pop.

DEMONSTRATION

1. Remove the rubber band from the Balloon Popper.
2. Inflate the balloon and attach to the Balloon Popper.
3. Hold up the Balloon Popper, grasping the arm with the balloon, with the nail below the balloon, oriented as shown in the side view. You may want to do this over a pillow or cushion.
4. Ask the students to predict what will happen when the Balloon Popper is dropped. Drop the Balloon Popper but catch it before it hits the floor. Try to catch it without forcing the nail towards the balloon!
5. The balloon should NOT pop when dropped without the rubber band. The entire apparatus falls together and there is no force to move the lower arm to come in contact with the balloon.
6. Re-install the rubber band (a.k.a. “Internal Force Generator”) between the two screws.
7. Hold up the Balloon Popper again, grasping the arm with the balloon, with the nail below the balloon, oriented as shown in the side view. You may want to do this over a pillow or cushion.
8. Ask the students to predict what will happen now when the Balloon Popper is dropped. Drop the Balloon Popper.
9. The balloon should pop almost immediately after release, so you should be able to catch it before it hits the floor. After "busting" the balloon, the Balloon Popper can be dropped without the balloon to observe the mechanics of the device's behavior. This should be done both with and without the rubber band.

EXPLANATION

1. Gravity pulls the entire apparatus downward. While held, the hand exerts an upward force on the upper wooden arm and gravity pulls the lower wooden arm downward. This stretches the rubber band.
2. During free fall, the Balloon Popper becomes “weightless” and the rubber band pulls the two wooden arms toward each other. That action then brings the nail and balloon together.
3. If the rubber band is not installed, there is no internal force to pull the wooden arms together and the balloon does not pop during the fall.

QUESTIONS

If you have questions about these instructions, please address them to:

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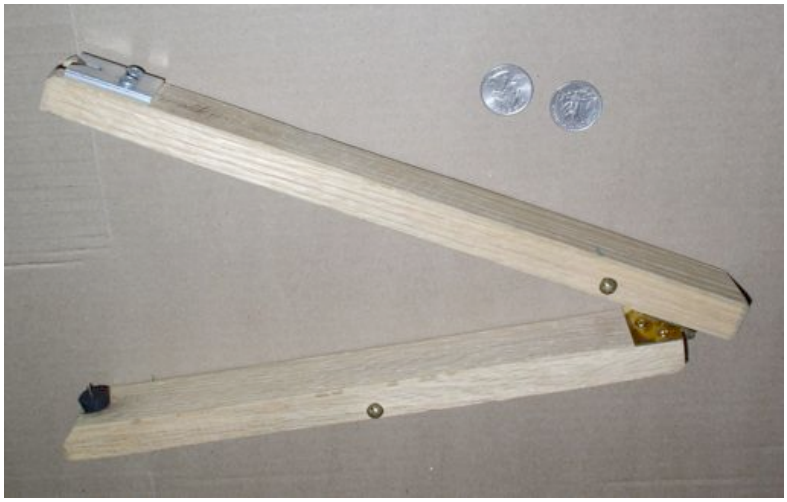
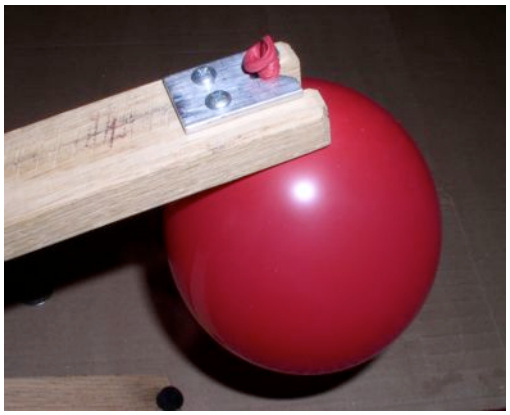
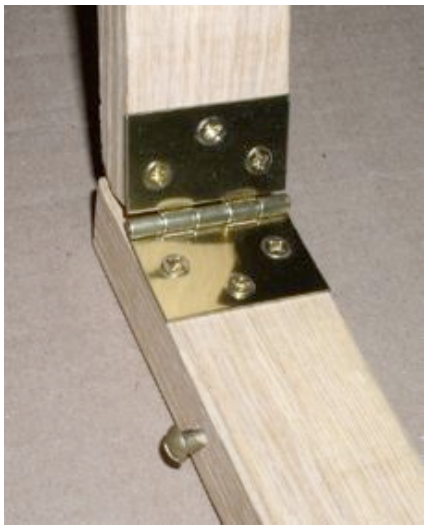
BALLOON POPPER
Microgravity Demonstrator



This is the frame of a balloon popper with two U.S. quarters to show the size. The components are two pieces of wood, a hinge, a balloon-attachment device, a stopper with small nail (or pin), and two screws. A rubber band is used but not shown in this picture.

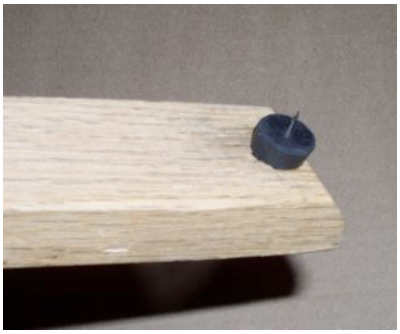


The balloon-attachment device is simply a piece of metal (or plastic) with a narrow notch to hold the knot of the balloon. The wood is notched below it to make room for the balloon neck. Other methods of holding the balloon could be used, such as a wooden clothes pin, hook and loop material, or a rubber band.

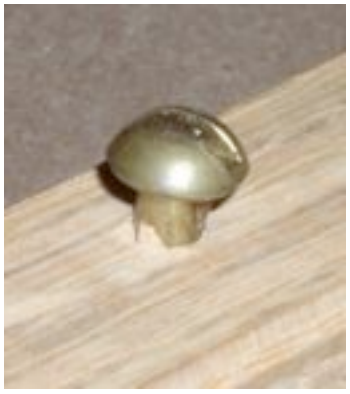



A hinge is mounted between the two pieces of wood as shown above.



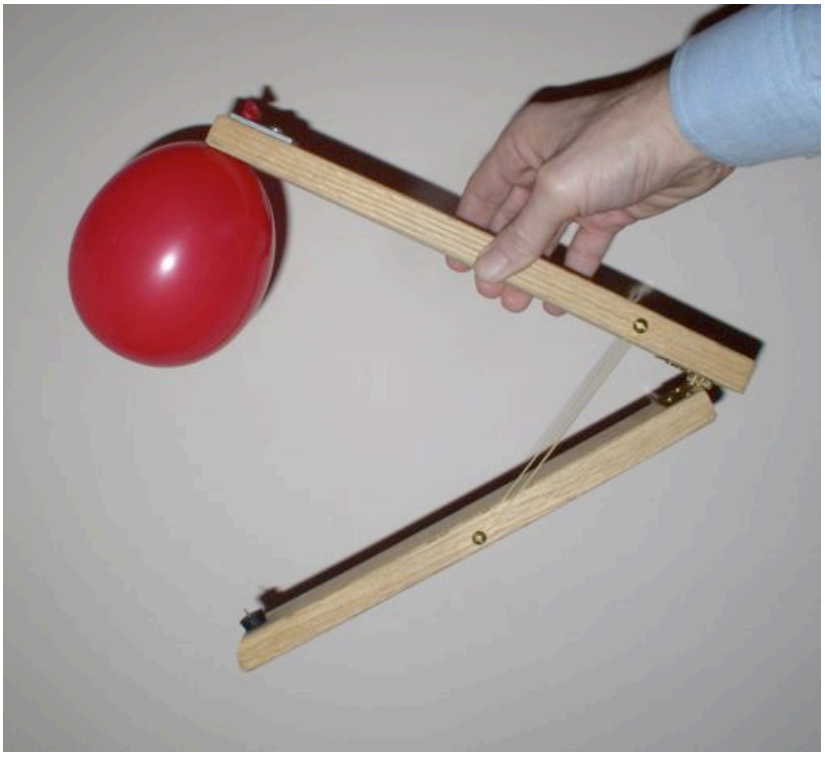


A small nail (commonly called a brad) is pushed through a rubber stopper (such as used in a laboratory). The stopper is then pushed into a hole drilled through one end of the wood frame. A small nail or sharp screw may be directly put into the wood using a pilot hole.



Two screws are put into the side of the wood pieces, but not screwed all the way in. The screw heads are left about 5 mm (or ¼ inch) from the wood. These are for the rubber band.

The completed balloon popper is shown with a rubber band installed between the two screws and with gravity pulling the lower piece of wood downward.



The final apparatus ready to demonstrate microgravity in free fall. When released to fall, the upward force exerted by the hand will not exist and the force of gravity will pull the entire apparatus downward. The internal force of the rubber band will cause the two arms to close together, bringing the nail in contact with the balloon.